Perceived critical success factors of electronic health record system implementation in a dental clinic context: An organisational management perspective

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ABSTRACT

Background: Electronic health records (EHR) make health care more efficient. They improve the quality of care by making patients' medical history more accessible. However, little is known about the factors contributing to the successful EHR implementation in dental clinics.

Objectives: This article aims to identify the perceived critical success factors of EHR system implementation in a dental clinic context.

Methods: We used Grounded Theory to analyse data collected in the context of Brunei's national EHR − the Healthcare Information and Management System (Bru-HIMS). Data analysis followed the stages of open, axial and selective coding.

Results: Six perceived critical success factors emerged: usability of the system, emergent behaviours, requirements analysis, training, change management, and project organisation. The study identified a mismatch between end-users and product owner/vendor perspectives.

Discussion: Workflow changes were significant challenges to clinicians' confident use, particularly as the system offered limited modularity and configurability. Recommendations are made for all the parties involved in healthcare information systems implementation to manage the change process by agreeing system goals and functionalities through wider consensual debate, and participated supporting strategies realised through common commitment.

1. Introduction

Healthcare organisations are information-intensive professional settings, where clinical decisions and the provision of patient-centred care rely on the timely accessibility of accurate information. The use of electronic health records (EHR) facilitates healthcare professionals' access to electronically-stored health information in a digital format [1–4], but its successful implementation depends on a combination of both technical and socio-organisational factors [5]. In particular, the confident adoption and use of EHR systems by clinicians is crucial for the overall success of EHR systems implementation, whereas a hasty deployment combined with lack of support and user resistance may result in implementation failure [6].

The implementation of EHR in various contexts has consistently attracted the attention of medical informatics research [7–11], but less so in a dental context or, more specifically, focusing on the nation-wide implementation of EHRs with integrated dental components. Studies addressing the use of EHR within a dental context have mostly focused on the benefits of integrating medical and dental EHR [12]. There is limited consideration of the challenges related to harmonising the dental care clinical workflow with the collection, review and representation of clinical data in EHR [13]. Similarly, and despite the acknowledgement that dentists' transition to EHR has been slowed by limited incentives and technical assistance [14], studies focusing on EHR in a dental clinic context are scarce.

In addressing these gaps, this study seeks to identify the perceived critical success factors of an EHR system implementation in a dental clinic context, as recognised by clinicians (general dental practitioners and specialists), IT officers and the system's operational manager. The focus of the article is on a nation-wide, recently implemented EHR – the Bru-HIMS system in Brunei Darussalam.

In what follows we present the theoretical context of the study. We then proceed to introduce the Grounded Theory methodology followed in the empirical part of the study. The research findings are presented

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subsequently in the form of major themes, after which they are discussed and integrated with the literature. The article closes with a summary of the study's contributions and research implications.

2. Theoretical context

The International Organization for Standardization defines the main purpose of an EHR system as the provision of a patient-centred record of health information that supports care within a medical environment [15]. The implementation of EHR systems and other health information technology initiatives in support of health care delivery has become common in countries' national healthcare systems (e.g. [16–22]. An important stream of research that analyses EHR systems has focused on patient concerns about the dimensions of patient-oriented usability [23,24], privacy [25,26] and security [27,28], but the focus of this article is on clinicians as end-users of Bru-HIMS, and on the organisational management challenges associated with the implementation of health information technologies [29].

The wide adoption of EHR systems is supported by reports of their positive impact on the quality and cost of healthcare delivery. More specifically, EHR systems are reported to contribute to reducing the incidence of problems such as lost records, duplication of effort, mistaken identity, drug administration errors, idiosyncratic clinical decisions and inefficient billing [30–34,5].

In an attempt to understand what determines EHR systems failure and success, [35] developed a framework that could illuminate the process of implementation. The proposed "design-reality" gap framework illustrates the differences in expectations and requirements from the two key stakeholders in the system: end-users and system designers. The framework evaluates these differences using a set of dimensions that operate as intervening factors: information; technology; processes; objectives; staffing; management systems; and other resources (IT-POSMO). An example of how disparities in access to resources and technology operate as an intervening factor lies in the public-private sector gap at the level of technology use in public and private hospitals [36].

In terms of implementation, the dental context may experience similar challenges to those of general EHR systems, such as technical glitches, consistency in data records and episodes of data loss [37–40]. In the dental context, problems have been reported at the levels of partial information coverage by computer-based patient record formats in comparison with paper-based records [41], negative impact on communication with patients due to use of the EHR system [42], and persistence of usability problems (e.g., unexpected ways of displaying diagnoses; presence of superfluous functions and absence of important functions; insufficient visibility; missing and mis-categorised terms) that impede clinicians from completing routine tasks, thus reducing efficiency, increasing frustration and potentially compromising patient safety [43].

Accordingly, in order to prevent and mitigate such challenges, it becomes essential to investigate the critical factors determining the implementation and adoption of health information systems (HIS), most notably the factors "related to the characteristics of users, tasks, systems, environment, and the impact of technology" [7].

3. Methods

Focusing on a deep exploration of the complex nature of HIS and how it is influenced by the particularities of context [44–46], we employed an interpretive Grounded Theory approach. In Grounded Theory, concepts are inductively generated from empirical qualitative data and the emerging result is presented as a theory built up around a core category and related categories [47]. For this study, data was collected in a single case-study research design. The implementation of Bru-HIMS in a dental clinic context was selected as the case-study context.

3.1. Setting

Bru-HIMS is Brunei Darussalam's nation-wide EHR system. It was promoted by the Ministry of Health, in partnership with a local IT company (Ministry of Health, 2014). Its development was part of a wider e-government initiative aimed at improving managerial effectiveness in public services, and represented an overall investment of B $1 billion in information systems infrastructure [48] Brunei Darussalam Public Sector Journey towards e-government, 2003). The Bru-HIMS system provides access to patients' health records to all clinics and hospitals in Brunei Darussalam Ministry of Health, 2014. It was developed taking into account all the different departments, workflows, and scope of the Brunei Healthcare System. This allows medical professionals and hospital administrators to access patients' health records at the point of care, regardless of their location. The dental clinic component under analysis in this article was part of Bru-HIMS's initial design. Most regions in Brunei have dedicated dental clinics (a total of 15 clinics throughout the country), and dental clinics represent one of Bru-HIMS's major components. Dental clinics are separate from the 4 main hospitals in the country. In the dental clinic context, the system is used daily by the totality of dental care providers: 34 general dental practitioners, 28 specialists, and 40 nurses and therapists. Fig. 1 offers an overview of the current dental information contained in Bru-HIMS.

3.2. Participants and interviews

In line with the University of Sheffield's ethics procedure, an ethics review form was submitted and approval granted on 3rd June 2014. The study did not involve any participant below the age of 18 and all interviewees were given the opportunity to read and sign a consent form. Participation in the study was voluntary and no financial reward or incentive were offered.

Participant selection operated through the combination of purposive and theoretical sampling techniques [49,50]. At a first stage, purposive sampling (i.e. the identification of major stakeholders as advised in [51] ensured that initial participants were knowledgeable of Bru-HIMS, and able to provide relevant information. Subsequently, a theoretical sampling strategy (i.e. sampling on the basis of the emerging analytical concepts as proposed by [47] was employed to select further participants.

Data collection developed through in-depth semi-structured interviews. Appendix A illustrates how the literature review informed the design of the interview guide. The literature review contextualised the study [52] and helped to develop theoretical sensitivity [47], i.e. the researchers' capacity to think about the data in theoretical terms. For example, a review of the Technology Acceptance Model's construct of perceived ease of use [53] informed the design of a qualitative interview question focusing on which features of the Bru-HIMS could be changed, with a view to improving ease of use. Similarly, a review of Heek's (2006) ITPOSMO dimensions (information, technology, objectives and values, skills and knowledge, management systems and structures, technology, and other resources) informed the design of qualitative interview questions addressing the match or mismatch between the system design *vis-a-vis* the local user reality. Appendix B contains the interview guides used in the study. In keeping with the process of semi-structured interviewing, the interview guide was used flexibly [54], allowing opportunities for free flowing, yet focused conversation. This was to ensure that the questions brought out the most in terms of experiences from the participants [55]. Notes and probe questions in every interview were recorded and used appropriately in the subsequent interviews.

Participants were interviewed in Brunei Darussalam, at their preferred time and location. After each interview, the notes and tapes were reviewed to ensure that no relevant information was missed. The average duration of the interviews was approximately 1 h. Each interview was recorded with an audio recorder and then transcribed